B.Tech Third Year (Odd Semester)						
Scheme (Batch 2016-17) Electronics Engineering						
Sr.No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**Credit**
1	EC3CO09	Control Systems	3	0	2	4
2	EC3CO11	Digital Communication	3	1	2	5
3	EC3CO13	Antennas and Propagation	3	1	2	5
4	EC3E*XX	EL-1	3	1	0	4
5	EC3E*XX	EL-2	3	0	0	3
6	EN3MC03	Technical Communication	2	0	0	0
7	OEXXXXX	OE-1	3	0	0	3
		Total	**20**	**3**	**6**	**24**
		Total Contact Hours	29			

EC3EC04	Satellite Communication
EC3EL03	Computer organization & Architecture
EC3ET04	Data Structures.
EC3EV07	VLSI Technology

Note: Open Elective will be given separately

B.Tech Third Year (Odd Semester)						
Scheme (Batch 2016-17) Electronics Instrumentation Engineering						
Sr.No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**Credit**
1	EI3CO09	Control Systems	3	0	2	4
2	EI3CO11	Sensors and Signal Conditioning	3	1	2	5
3	EI3CO13	Analytical and Industrial Instrumentation	3	1	2	5
4	EI3ELXX	Program Elective-I	3	1	0	4
5	EI3ELXX	Program Elective-II	3	0	0	3
6	EN3MC03	Technical Communication	2	0	0	0
7	OEXXXXX	Open Elective-I	3	0	0	3
8	EN3MC01	Open Learning Course Name	1	0	0	0
		Total	**21**	**3**	**6**	**24**
		Total Contact Hours	30			

EI3EC04	Satellite Communication
EI3EL03	Computer organization & Architecture
EI3ET04	Data Structures.
EI3EV07	VLSI Technology

Note: Open Elective will be given separately

Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
EC3CO09 / EI3CO09	Control System	3	0	2	4

UNIT I Introduction

Concept of control system, basic terminology, objectives/specifications. Mathematical modeling of physical systems such as mechanical and electrical systems, differential equations, transfer function, block diagram representation and reduction, signal flow graph techniques, Mason's Gain formulae. Concept of feedback, open loop and closed loop systems, types and effects of feedback.

Basic control system components: Error detectors, Gears, Gyroscope, DC motors, Servomotors, Techo-generators, Servo amplifiers.

UNIT II Time response analysis

Standard test signals, time response analysis (1^{st} and 2^{nd}order), Transient and steady state response, response parameters and their qualitative analysis; Transient and steady state response analysis for 1^{st} and 2^{nd} order systems with negative feedback ; effect of close loop on system parameters. Stability of linear systems, stability norms, effects of pole location on system stability, necessary

conditions for stability, Routh-Hurwitz stability criteria, relative stability analysis, Root Locus concept, guidelines for sketching Root-Locus., applications of root locus.

UNIT III Frequency response analysis

Concept of frequency response, Frequency response plots such as Polar plots, Bode Plots, log-magnitude versus Phase-Plots, M and N circles, Correlation between time and frequency response.

Frequency domain stability analysis, Nyquist stability criterion, stability margins: phase margin and gain margin, Relative stability analysis using Nyquist plot and Bode plot.

UNIT IV Compensators and controllers

Design problem, types of compensation techniques, design of phase-lag, phase lead and phase lead-lag compensators in time and frequency domain. P, PD, PI, PID error control strategies; effect of controllers on transient and Steady state response.

UNIT V State space analysis

State space representation of systems, State Space equations in Canonical forms, Modeling of electrical and mechanical systems in State Space form, Solution of state space equation, state transition matrix, Controllability and Observability, Relation between transfer function and state space representations, Design of state feedback controller.

Text books

1. J. Nagrath and M. Gopal, Control Systems Engineering, New Age International Publishers.
2. B. C. Kuo, Automatic Control systems, Wiley India Pvt. Ltd.
3. K. Ogata, "Modern Control Engineering", PHI.

Reference Books

1. M. Gopal, Control System Principles and Design, Tata McGraw Hill, New Delhi.
2. S. Salivahanan, Control System Engineering, Pearson Education, New Delhi.

List of Practicals

1. Transfer Function from Zeros and Poles
2. Zeros and Poles from Transfer Function
3. Impulse, Step and Ramp Response ofA Transfer Function
4. Time Response ofa Second Order System
5. Root Locus for a Transfer Function
6. Bode Plot for Transfer Function
7. Nyquist Plot for a Transfer Function
8. Transfer Function from State Model State Model from Transfer Function
9. State from Zeroes and Poles Zeros And Poles From State Model
10. Lag and Lead Compensator
11. Pid Controller

Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
EC3CO11	Digital Communication	3	1	2	5

UNIT I Digital communication system model, analog vs. digital communication; Fundamental limitations of communication systems. PCM, Quantization (uniform and non-uniform), quantization noise, DPCM, ADPCM, DM, ADM. Audio and video compression.

UNIT II Baseband Pulse Transmission: Line coding: Characteristics of line codes, NRZ and RZ forms of unipolar, polar, bipolar and bi-phase line codes, their waveforms & PSD. **Baseband demodulation techniques:** Matched filter, Inter Symbol Interference, Pulse shaping (Raised cosine spectrum, duo-binary signaling), Equalization, Eye patterns. **Signal-space representation:** Geometric representation of signals and WGN. MAP and ML detectors. Error performance of detectors.

UNIT III Digital Passband Modulation, Demodulation and Spread Spectrum techniques: BPSK, DPSK, QPSK, BFSK, M-ary PSK & FSK, MSK, QAM, Non-coherent BFSK and DPSK: Their generation, detection, waveforms, PSDs, performance of these systems in the presence of noise. Introduction to Spread Spectrum techniques: Spread Spectrum overview, pseudo-noise sequence, Direct Sequence & Frequency Hopping Spread Spectrum.

UNIT IV Introduction of Information theory: Concept of amount of information, entropy & its types, source encoding such as Shannon-Fano, Huffman Codes, Information rate, Channel capacity (its calculation for BSC, BEC, noiseless channels and Gaussian channel), Shannon's theorem, Bandwidth and S/N trade off.

UNIT V Channel coding: Linear Block codes (Systematic codes, Parity check matrix, Syndrome testing), Cyclic codes, Hamming codes, BCH codes, Convolutional codes. Low Density Parity Check codes. Block codes

Text Books

1. S. Haykin, Digital Communication, John Wiley & Sons.
2. B. P. Lathi, Modern Digital and Analog Communication Systems, Oxford University Press.
3. H. Taub & D. Schilling, Principles of Communication System, TMH.

Reference Books

1. J. G. Proakis & M. Salehi, Digital Communications, McGraw-Hill International.
2. M. S. Roden, Analog and Digital Communication Systems, Discovery Press.
3. B. Sklar, Digital Communications, Pearson.

Web resources

1. Prof. Bikash Kumar Dey, Digital Communication, IIT Bombay (nptel.iitm.ac.in)\
2. Saswat Chakrabarti, Prof.R.V. Rajakumar, Digital Communication, Prof., IIT Kharagpur (nptel.iitm.ac.in)
3. Prof. Lizhong Zheng, Prof. Robert Gallager, Principles of Digital Communications I, MIT

List of Practicals

1. Understand the concept of TDM and perform four channel time division multiplexing and de multiplexing operation.
2. Generate PCM, learn transmitter and receiver system based on PCM
3. Generation of modulated signal based on Delta and Adaptive Delta method and demodulates them.
4. Generate and observe the data using various data formatting techniques.
5. Perform Experiment based on digital companding techniques (A-law & μ-law)
6. Study of digital carrier techniques (ASK, FSK, PSK) transmitter and receiver system.
7. Experiments based on MATLAB Simulation tool
    a. To design and verify the operation of ASK, FSK and PSK generator & demodulation
    b. Calculate BER of ASK, FSK & PSK using constellation diagram.
8. Write a program for determination of various entropies and mutual information of a given channel. Test various types of channel such as
    a) Noise free channel. c) Binary symmetric channel
    b) Error free channel d) Noisy channel
9. Write a program for generation and evaluation of variable length source coding using
    a) Shannon –Fanocodingandecoding b) Huffman Coding and decoding
10. Write Programs for coding & decoding of Linear block codes and cyclic code.

Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
EC3CO13	Antennas and Propagation	3	1	2	5

UNIT I

BASIC CONCEPTS OF RADIATION

Basic sources of Radiation i.e. Single-wire, Two-wires, Dipole, Radiation Integral and Auxiliary Potential Functions. Basic antenna parameters – Types of Radiation pattern, Antenna field Zones, Radiation power density, Radiation Intensity, Beamwidth, Directivity, Antenna efficiency, Gain, Beam efficiency, Bandwidth, polarization, Antenna Impedance, Antenna Vector effective length and Equivalent Area, Maximum Effective Area, Friis transmission and Radar range equation, Reciprocity Theorem. **Radiation from Wires** - Infinitesimal dipole, finite-length dipole, Half dipole, Monopole antenna.

UNIT II

ANTENNA ARRAYS ANALYSIS AND SYNTHESIS

Two element arrays – different cases, Principle of Pattern Multiplication, N element Uniform Linear Arrays – Broadside, Endfire Arrays, EFA with Increased Directivity; Concept of Scanning Arrays. Binomial Arrays, Effects of Uniform and Non-Uniform Amplitude Distributions, Related Problems. **Antenna Synthesis-** Schelkunoff Polynomial Method, Fourier Transform Method, Doph-Chebyshev Synthesis Method, Synthesis Related Problems.

UNIT III

SPECIAL ANTENNAS

Traveling wave, slot, Loop and folded dipole antennas, Arrays with Parasitic Elements, Yagi - Uda Arrays & their characteristics, Log Periodic Antenna, Reflector Antennas: Flat Sheet and Corner Reflectors. Paraboloidal Reflectors – Geometry, characteristics, types of feeds, F/D Ratio, Spill Over, Back Lobes, Aperture Blocking, Off-set Feeds, Cassegrain Feeds. **Helical Antennas** – Significance, Geometry, basic properties; Design considerations for monomial helical antennas in Axial Mode and Normal Modes (Qualitative Treatment). Horn Antennas – Types, Optimum Horns, Design Characteristics of Pyramidal Horns; Base Station Antenna, Mobile Station Antenna.

UNIT IV

MICRO STRIP ANTENNA

Radiation from rectangular and circular patches, feeding techniques. Rectangular patch radiation analysis from cavity model; input impedance of rectangular patch; Basic Knowledge Microstrip array and feed network; Introduction to CAD tools used for antenna modeling i.e. CST, HFSS, IE3D.

UNIT V

PROPAGATION OF RADIO WAVE

Basics of propagation – Ground wave propagation, Effect of Earth on Radiation Pattern, Space wave propagation – considerations in space wave propagation , super refraction , Ionospheric wave propagation - Structure of ionosphere mechanism of Ionospheric propagation, Effect of earth's magnetic field on radio wave propagation, Virtual height, MUF, Skip distance, OWF, Ionosphere abnormalities.

Text Books

1. A. Balanis, Antenna Theory Analysis and Design, John Wiley and Sons, NewYork.
2. J.D. Kraus, Antennas for All Application, Tata McGraw-Hill.
3. E. C. Jordan and K. G. Balmain. Electromagnetic Waves and Radiating System, PHI Learning

Reference Books

1. R.E. Collin and F. Zucker– "Antenna theory" Part I, Tata Mc Graw Hill, NewYork.
2. I.J. Bahl and P. Bhartia," Microstrip Antennas", ArtechHouse, Inc.

Website Resources

1. Online Antennas course by IIT Bombay https://onlinecourses.nptel.ac.in/noc18_ee13.
2. You Tube Video on antennas https://www.youtube.com/channel/UCjzx-cRhnmymh18W18sMdjw/videos.

List of Practicals

1 Introduction of a Motorized Antenna Trainer Kit & Knowledge of Antenna designing tools like IE3D, HFSS and CST

2 Design and analysis of Simple Dipole (L = 3λ/2, λ/2, λ/4) antenna using full wave simulator.
Plotting & Comparisons of the Polar graph/ radiation pattern of Simple Dipole (L = 3λ/2,λ/2, λ/4) antenna using Antenna Trainer Kit

3 I. Design and analysis of Yagi-UDA 5 & 7 Element Simple dipole antenna using full wave simulator.
II. Plot the Polar graph/ radiation pattern & Comparisons of Yagi-UDA 5 & Element Simple dipole antenna using Antenna Trainer Kit.

4 I. Design and analysis of Yagi-UDA 3 & 5 Element Simple dipole antenna using full wave simulator.
II. Plot the Polar graph/ radiation pattern & Comparisons of Yagi-UDA 3 & Element Simple dipole antenna using Antenna Trainer Kit.

5 I. Design and analysis of Log Periodic & Helix Antenna using full wave simulator.
II. Plot the Polar graph/ radiation pattern of Log Periodic & Helix Antenna using Antenna Trainer Kit.

6 I. Design and analysis of slot, Loop and Rhombus Antenna using full wave simulator.
II. Plot the Polar graph/ radiation pattern & Comparisons of slot ,Loop and Rhombus antenna using Antenna Trainer Kit

7 I. Design and analysis of cut Parabolic Reflector Antenna using full wave simulator.
II. Plot the Polar graph/ radiation pattern of cut Parabolic Reflector antenna using Antenna Trainer Kit

8 I. Design and analysis of λ /2 Phase Array (End fire) antenna & λ / 4 Phase Array (End fire) Antenna using full wave simulators.

	II.	Plot the Polar graph/ radiation pattern of λ /2 Phase Array (End fire) antenna & λ / 4 Phase Array (End fire) antenna using Antenna Trainer kit.
9	I.	Design and analysis of λ /2 Phase Array (End fire) antenna & λ / 4 Phase Array (End fire) Antenna using full wave simulators.
	II.	Plot the Polar graph/ radiation pattern of Combined Co-Linear Array and Broadside Array Antenna
10	I.	Design and Analysis of Microstrip Patch antenna for Wi-Fi Application using full wave simulator.

[* All antennas should be design & simulate for 750MHz/ 1GHz Frequency using any full wave simulator.]

Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
EC3EC04 / EI3EC04	Satellite Communication	3	0	0	3

UNIT I Basic Principles of Satellite
Introduction, Evolution and growth of satellites, General features, frequency allocation for satellite services, properties of satellite communication systems, role and application of Satellite Communication

UNIT II Satellite Orbits
Elements of orbital mechanics, Equation of Motion, Kepler's laws, orbital characteristics, satellite spacing and orbital capacity, angle of elevation, eclipses, launching and positioning, satellite drift and station keeping

UNIT III Satellite Space Segment
Attitude and orbit control system; telemetry, tracking and command; power systems, communication subsystems, antenna subsystem, equipment reliability and space qualification

UNIT IV Satellite Links and Earth station
General link design equation, system noise temperature, uplink design, downlink design, complete link design, effects of rain, earth station subsystem, different types of earth stations

UNIT V Multiple Access and Capacity Enhancement
Space segment access methods, TDMA, FDMA, CDMA, SDMA, assignment methods, Nonlinearity, Synchronization

Text books

1. Timothy Pratt, Charles W. Bostian, Satellite Communications, John Wiley & Sons 2001.
2. Dennis Roddy, Satellite Communications, 3rd Ed., Mc. Graw-Hill International Ed. 2001.
3. W L. Pritchard, HG. Suyderhoud, RA. Nelson, "Satellite Communication System Engineering".

Reference Books

1. D. C. Agarwal, Satellite Communications, Khanna Publishers
2. K. N. Raja Rao, Fundamentals of Satellite communications, PHI Learning.

Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
EC3EL03/EI3EL03	Computer Organization &Architecture	3	1	0	4

UNIT I

Fundamentals of Computer Architecture:

Evolution of Computers, Computer Classification, Measuring Computer Performance, von Neumann Machine Architecture, Functional Units and Components in Computer Organization, Fundamental concepts – Execution of a complete instruction – Multiple bus organization – Hardwired control – Micro programmed control, Bus Structures-PCI, SCSI, USB.

UNIT II

Instruction Set Architecture

Representation of Positive and Negative Numbers, Binary Fixed- Point Representation, Floating Point Representation, Memory Locations and Addresses, Instructions and Instruction Sequencing, Addressing Modes, RISC and CISC Instruction set formats.

UNIT III

Pipelining and Parallel Processing

Basics of pipelining, Role of Cache memory, Pipeline performance, Data hazards, Instruction hazard, Parallel Processing- Basic Concept of program, process, thread, type and level of parallelism, Superscalar operation concept, Vector and Array Processor, Multithreaded Processors.

UNIT IV

Memory Hierarchy Design

Memory Hierarchy, Internal Organization of Semiconductor Main Memory Chips, Virtual memory System, Memory allocation and management, Cache Memories and Management, Crosscutting issues in the design of Memory Hierarchies, Classification of Shared Memory Systems

UNIT V

Advanced Processing Unit

Multiprocessor Architectures organization – Performance characteristics of Multiprocessors, Multi-core Architectures- Flynn Classification, Inter-processor Communication, Cluster Computing.

Text Book

1. Carl Hamacher, Zvonko Vranesic and Safwat Zaky, Computer Organization, McGraw-Hill.
2. Nicholas Carter and Raj Kamal, Computer Architecture and Organization, Schaum ' s Outlines, Tata McGraw-Hill.
3. K. Hwang & F. A. Briggs, Computer Architecture and Parallel Processing, TMH

Reference Book

1. K. A. Parthasarathy, A. Ramachandran, R. Purushothaman, Advanced Computer Architecture, Advanced Computer Architecture, Thomson Learning,
2. J. L. Hennessy, D. A. Patterson, Computer Architecture: A Quantitative Approach, Elsevier
3. D. Sima, T. Fountain & P. Kacsuk. Advanced Computer Architectures, Pearson Education

Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
EC3ET04/EI3ET04	Data Structures	3	0	0	3

UNIT I Linear Data Structures:
Abstract Data Types - Asymptotic Notations: Big-Oh, Omega and Theta – Best, Worst and Average case Analysis: Arrays: Definitions, Representations and Examples – Stacks and Queues, Linked List, Linked List based implementations of Stack and Queues, Evaluation of Expressions – Linked list based polynomial addition. Applications of Linked List, Arrays and Queues in Computer field.

UNIT II Non-Linear Data Structures:
Trees: Binary Trees, Binary tree representation and traversals, Threaded binary trees, Binary tree representation of trees. Application of Trees: Set representation and Union; Find operations, Graph and its representations, Graph Traversals, Connected components.

UNIT III Search Structures and Priority Queues:
AVL Trees: Red-Black Trees, Splay Trees, Binary Heap, Leftist Heap. Applications of Queues in computer field.

UNIT IV Sorting:
Insertion sort, Merge sort, Quick sort, Heap sort, Sorting with disks – k-way merging – Sorting with tapes – Polyphase merge. Applications of sorting in computer field.

UNIT V Searching and Indexing:
Linear Search, Binary Search, Hash tables, Overflow handling, Cylinder Surface Indexing – Hash Index – B-Tree Indexing. Applications of searching and indexing in computer field.

Text Books

1. Ellis Horowitz and Sartaj Sahni, Fundamentals of Data Structures, Galgotia Book Sorce, Gurgaon.
2. Gregory L. Heilman, Data Structures, Algorithms and Object-Oriented Programming, Tata Mcgraw-Hill, New Delhi.

Reference Books

1. Jean-Paul Tremblay and Paul G. Sorenson, An Introduction to Data Structures with Applications, Second Edition, Tata McGraw-Hill, New Delhi.
2. Alfred V. Aho, John E. Hopcroft and Jeffry D. Ullman, Data Structures and Algorithms,
   Pearson Education, New Delhi.
3. Seymour Lipschutz, Data Structures, Schaum's Outlines Series, Tata McGraw-Hill

Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
EC3EV07/EI3EV07	VLSI Technology	3	0	0	3

UNIT I

Environmental conditions for VLSI technology: clean room and safety requirements, Different crystalline orientation, Crystal defect, Wafer cleaning process and wet chemical etching techniques, CZ method, wafer preparation techniques.

UNIT II

Oxidation: kinetics of silicon dioxide growth for thick, thin and ultra-thin films. Oxidation technologies in VLSI and ULSI; Characterization of oxide films, Methods of Impurity incorporation, solid-state diffusion modeling and technology, Ion implantation techniques

UNIT III

Lithographic techniques: Photolithography techniques for VLSI, Mask Generation.
Chemical Vapour deposition techniques: CVD techniques for deposition of polysilicon, silicon dioxide, silicon nitride and metal films; epitaxial growth of silicon; modeling and technology.

UNIT IV

Metallization techniques: evaporation and sputtering techniques, multilevel Metallization schemes. Masking Sequence and Process flow for MOS and BIPOLAR Devices.

UNIT V

LAYOUT DESIGN RULES: Need for Design Rules, Rules for the Silicon Gate NMOS Process, CMOS Based Design Rules, Simple Layout Example.

Text Books

1. S.M.Sze (Ed), "VLSI Technology", McGraw-Hill.
2. C.Y. Chang and S.M. Sze (Ed), "ULSI Technology", McGraw-Hill Companies Inc.

References Books

1. S.K.Gandhi, "VLSI fabrication Principles", John Wiley Inc., New York
2. Sorab K. Gandhi, "The Theory and Practice of Microelectronics", John Wiley & Sons
3. B.G Streetman, "VLSI Technology", Prentice Hall

Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
EN3MC03	Technical Communication	2	0	0	0

UNIT I Basics of Technical Communication
Introduction, Objective and characteristics of technical communication, Importance and need for technical communication, Principles of scientific vocabulary, Importance of visual aids in technical communication

UNIT II Listening and speaking
Barriers to effective listening, Active listening, traits of a good listener, the art of note taking, Effective presentation strategies, Face to face interview, group discussion skills, persuasive speaking, research presentation: conferences, symposia and seminars.

UNIT III Reading and writing
Interpretation of ideas and graphics in technical literature, Factual and inferential comprehension, understanding the gist of content, use of right words and phrases, salient points of sentence construction, paragraph construction, cohesion and coherence, revising.

UNIT IV Technical and formal documentation
Audience specific documentation, Technical report writing, designing user manual and instruction manual, lab report, technical description, test-plans, application note, technical proposal and presentation, resume and job application, cover-letter

UNIT V Research documentation
Synopsis, Research paper, dissertation and thesis, writing abstract and summary, sectioning and formatting, creation and effective use of charts graphs illustrations and tables, referencing and styling, ethics in research documentation, citation and plagiarism.

Text books

1. Meenakshi Raman, Sangeeta Sharma, "Technical Communication Principles and Practice", Oxford Higher Education.
2. M. Ashraf Rizvi, "Effective Technical Communication", Mcgraw Hill Publishers.
3. Daniel G. Riordan, "Technical Communication", Cengage Learning.

Reference Books

1. Barry J. Rosenberg, "Spring into Technical Writing for Engineers and Scientists", Pearson Education.
2. K. K. Sinha, "Technical Communication", Taxmann's Publication.
3. Pfieffer and Padmaja, "Technical Communication: A Practical Approach", Pearson Educations.

Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
EI3CO11	Sensors and Signal Conditioning	3	1	2	5

UNIT I

Science of Measurement

Units and Standards, Calibration techniques, Errors in Measurements, generalized Measurement System, Sensors & Transducers, Transduction principles, Classification of transducers, Criteria for transducer selection, Static and dynamic characteristics of transducers, Generalized Performance of Zero Order and First Order Systems, Response of transducers to different time varying inputs, Classification of transducers

UNIT II

Mechanical Measurements

Temperature: Filled thermometer, Bimetallic thermometer, Manometers, Elastic transducers, Bourdon gauge, Bellows, Diaphragm. Flow measurement: Orifice, Venturi, Nozzle, Pitot tube, Turbine flow meter, Hotwire-anemometer

UNIT III

Electrical Measurements

Resistive transducers: Potentiometer, RTD, Thermistor, Thermocouple, Strain gauges, Use in Displacement, Temperature, Force measurement Inductive transducer: LVDT, RVDT, Use in displacement measurement Capacitive transducer: Piezoelectric transducer, Digital displacement transducers

UNIT IV

Smart Sensors

Radiation sensors, Smart sensors, Film sensor, MEMS & Nano Sensors, Applications: Automobile, Aerospace, Home appliances, Manufacturing, Medical diagnostics, Environmental monitoring.

UNIT V

Signal Conditioning & Data Acquisition

Signal Conditioning: Concept of signal conditioning, Amplification, Filtering, Averaging, Introduction to AC-DC Bridges. Op-amp circuits used in instrumentation, Instrumentation amplifiers, Sample and Hold circuits, Introduction to A/D and D/A conversion, Noise in measurement, grounding and shielding. Data Acquisition: Single channel and multi-channel data acquisition, Data logging.

Text Books

1. Ernest O Doebelin, "Measurement Systems, Applications and Design", Tata McGraw Hill.
2. A K Sawhney, "A Course in Electrical and Electronic Measurement and Instrumentation", Dhanpat Rai and Co (P) Ltd.
3. D Patranabis, "Sensors and Transducers", 2nd edition PHI, New Delhi.

Reference Books

1. D. Roy Choudhary, Sheil Jain, "Linear Integrated Circuits", New Age International Pvt. Ltd.
2. H S Kalsi, "Electronic Instrumentation", Tata McGraw Hill, New Delhi.

List of Practicals

1. Measurement of displacement using LVDT
2. Measurement of current/ voltage using Hall effect transducer.
3. Thermocouple based ON – OFF controller
4. Measurement of strain using strain gauge
5. Measurement of temperature by RTD method
6. Measurement of flow rate by anemometer
7. Measurement of intensity of light by photo transducers
8. Measurement of displacement using capacitive pickup
9. Op-amp circuits used in instrumentation
10. A/D and D/A conversion
11. Design and development of Data loggers

Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
EI3CO13	Analytical and Industrial Instrumentation	3	1	2	5

UNIT I

Fundamentals of Analytical instruments:

Introduction to Analytical Instrumental Analysis, Difference between analytical and other instruments.

Spectrometric Methods: Laws of Photometry, UV, visible instrument component, Various types of UV-visible spectrophotometers photo colorimeters, Single and Double beam instruments.

UNIT II

Separative Methods

Mass Spectrometer: Principle, ionisation methods, mass analyzer types – Magnetic Deflection type, time of flight, quadruple, double focusing, resolution of Mass Spectrometer

Chromatography: Fundamentals of chromatographic Separations, Classification, Gas chromatographic system with components, factors affecting separation, applications Analysis of Gas Chromatogram Thermal conductivity method, Heat of reaction method. Estimation of oxygen, hydrogen, methane, carbon dioxide, CO, etc. Zirconia-probe oxygen analyser. Paramagnetic oxygen meters, Electrochemical reaction method.

UNIT III

Radioactive Instrumentation:

X ray and its properties, production of X rays, X-ray spectrometry: Instrumentation for X-ray spectrometry, X-ray diffractometer: Bragg's law, X-Ray fluorescence methods, X-Ray absorption methods.

Radiation detectors: Ionisation chamber, Geiger-Muller counter, proportional counter, scintillation counters.

UNIT IV

Chemical composition Analysis:

Measurement of Viscosity, turbidity. pH Meters and dissolved component analyzers :Principle of pH measurement,glass electrodes, hydrogen electrodes, Reference electrodes, Electrical conductivity, Techniques of density measurement Solids, liquids and gases

UNIT V

Environmental Pollution Monitoring Instruments:

Air pollution monitoring instruments carbon monoxide, sulphur dioxide, Nitrogen oxides, Hydrocarbons, Ozone and Automated wet chemical air analysis. Water pollution monitoring instruments.

Text Books

1. R.S. Khandpur, Handbook of Analytical Instruments, Tata McGraw Hill publishing Co. Ltd.
2. D. Patranabis, Principles of Industrial Instrumentation, 3rd Edition, Tata McGraw Hill Publishing Company Ltd., New Delhi.
3. E.B. Jones., Instrument Technology, Vol.2, Butterworth-Heinemann, International Edition.

Reference Books

1. Bela G.Liptak, Instrumentation Engineers Handbook (Measurement), CRC Press
2. E.O. Doebellin,and D.N. Manik, Measurement systems Application and Design, Special Indian Edition, Tata McGraw Hill Education Pvt. Ltd.

List of Practicals

1. To demonstrate the working of Gas chromatograph.
2. Detect concentration of species in collected sample using spectrophotometer.
3. Determine the turbidity of a given sample by using turbidity meter.
4. Measurement of conductivity by using water analysis kit.
5. Measurement of pH by using water analysis kit.
6. Measurement of dissolved oxygen by using water analysis kit.
7. Measurement of total dissolved solids by using water analysis kit.
8. Study of Digital conductivity meter.
9. To examine the optical density of a given sample using Photoelectric Colorimeter.
10. Study of mass spectrometer.